SUMMER JOB OFFER

Suggested Grades

8^{th} or 9^{th} Grade Pre-Algebra or Algebra

SD Mathematics Strand & Standard (Primary for Task)

Number Sense

9-12.N.1.2 Students are able to apply the concept of place value, magnitude, and relative magnitude of real numbers.

Task Summary

Students investigate salary options and justify the payment method that will result in the highest salary.

Time and Context of Task

1 class period. Use anytime when discussing salary and want to pique interest in number patterns. This task can be used as a group activity or as an individual activity.

Materials Needed

Paper, Pencil, Calculator

Author and Lead Teacher for This Task

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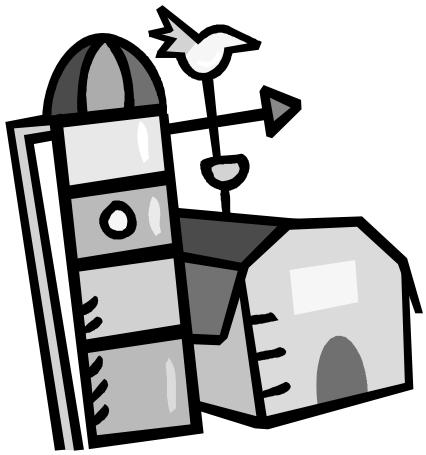
You have been looking for a summer job but have not had much success. One day an out of state businessman, who owns a local hog operation, learns of your search. He is in need of someone to take over some duties on his farm during the month of July. Upon recommendation from your references he calls you and offers an intriguing job offer. Here is what the businessman proposed. "I have need of general farm services for the 18 days in July. This includes feeding the livestock, cleaning hog pens, and general maintenance every day worked. This must be done seven days a week, roughly 75 hours a week. I am willing to pay you a lump sum of $1800 for the 18 days in July or offer to pay you 1 cent for the first day of work, 2 cents for the second day of work, 4 cents for the third day of work, and so on (double previous days earnings each day). Are you interested?"

You tell him you are interested but find this offer somewhat perplexing. Which way would you prefer to be paid? Prepare a presentation for your class which justifies your decision. Your presentation should include comparison of each payment option.



CONTENT STANDARDS

Primary Standard

Strand Name: Number Sense

SD Goal: Students will develop and use number sense to investigate the characteristics of numbers in a variety of forms and modes of operation.

Indicator 1: Analyze the structural characteristics of the real number system and its various subsystems. Analyze the concept of value, magnitude, and relative magnitude of real numbers.

Standard: 9-12.N.1.2 Students are able to apply the concept of place value, magnitude, and relative magnitude of real numbers.

Supplemental Standard

Strand Name: Number Sense

SD Goal: Students will develop and use number sense to investigate the characteristics of numbers in a variety of forms and modes of operation.

Indicator 2: Apply number operations with real numbers and other number systems.

Standard: 9-12.N.2.1 Students are able to add, subtract, multiply, and divide real numbers including integral exponents.

NCTM Process Standard

Communication: Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.

Reasoning & Proof: Select and use various types of reasoning and methods of proof.

Connections: Recognize and apply mathematics in contexts outside of mathematics.

Problem-Solving Strategies

- Drawing pictures, graphs, and tables;
- Looking for patterns

ASSESSMENT TOOLS

Task Rubric

	Advanced	Proficient	Basic	Below basic
9-12.N.1.2 Students are able to apply the concept of place value, magnitude, and relative magnitude of real numbers.	Draws and justifies valid and precise conclusions about salary options. Able to achieve an accurate and reasonable solution.	Draws and justifies some valid conclusions about salary options that lead to a reasonable solution.	Able to establish a form of number pattern for money earned in the daily payment option. Draws some valid conclusions but justification lacks convincing evidence.	Draws no conclusion or draws an invalid conclusion. No evidence or no attempt made to do any computation.
Convincing Presentation	Presentation shows complete understanding of the mathematical concepts used. It is organized, clear, and convincing.	Presentation shows substantial understanding of the mathematical concepts used. Some organization. Conclusions are somewhat convincing.	Presentation shows some understanding of the mathematical concepts used. Very little organization. Conclusions are not convincing.	Presentation shows very limited understanding of the underlying concepts needed or no attempt to convince.

Eighth Grade Number Sense
Performance Descriptors

Advanced	**Eighth grade students performing at the advanced level:** • justify problem-solving strategies used in multi-step situations within the set of rational numbers.
Proficient	**Eighth grade students performing at the proficient level:** • read, represent, estimate, and calculate using the set of rational numbers; • apply problem-solving strategies in multi-step situations using the set of rational numbers.
Basic	**Eighth grade students performing at the basic level:** • read, represent, estimate, and calculate integers and positive fractions; • apply problem-solving strategies in one- and two-step situations with integers and positive fractions.

Eighth Number Sense
ELL Performance Descriptors

Proficient	**Eighth grade ELL students performing at the proficient level:** • read, represent, estimate, and calculate rational numbers; • apply problem-solving strategies in contextual situations; • read, write, and speak the basic language of mathematics.
Intermediate	**Eighth grade ELL students performing at the intermediate level:** • read, represent, estimate, and calculate integers and positive fractions; • apply problem-solving strategies in contextual situations; • explain in mathematical terms the sequence of steps used in solving problems; • give simple oral or written responses to directed questions on topics presented in class.
Basic	**Eighth grade ELL students performing at the basic level:** • perform arithmetic functions using integers; • recognize and use basic mathematical terms; • respond to yes or no questions and to problems presented pictorially or numerically in class.
Emergent	**Eighth grade ELL students performing at the emergent level:** • respond to problems using addition, subtraction, multiplication, and division; • copy and write numerical symbols; • imitate pronunciation of numbers and mathematical terms; • use non-verbal communication to express mathematical ideas.
Pre-emergent	**Eighth grade ELL students performing at the pre-emergent level:** • observe and model appropriate cultural and learning behaviors from peers and adults; • listen to and observe comprehensible instruction and communicate understanding non-verbally.

Core High School Number Sense
Performance Descriptors

Advanced	**High school students performing at the advanced level:** • classify a number as real, pure imaginary, or complex; • evaluate numerical expressions using rational exponents; • explain a reasonable solution to a problem.
Proficient	**High school students performing at the proficient level:** • identify the subsets of the set of real numbers to which a given number belongs; • evaluate numerical expressions using integral exponents; • check reasonableness of a solution to a problem.
Basic	**High school students performing at the basic level:** • give an example of each of the following: a whole number, an integer, and a rational number; • evaluate numerical expressions using whole number exponents.

High School Number Sense
ELL Performance Descriptors

Proficient	**High school ELL students performing at the proficient level:** • use computational strategies to evaluate numeric expressions including roots and exponents within the set of real numbers; • identify the subsets of the set of real numbers to which a given number belongs; • justify reasonableness of solutions orally or in writing; • read, write, and speak the language of number sense and apply it to number sense problem-solving situations.
Intermediate	**High school ELL students performing at the intermediate level:** • use computational strategies to evaluate numerical expressions within the set of rational numbers; • perform basic operations on algebraic expressions; • create numerical expressions from oral or written contexts; • use number terms to explain the sequence of steps and/or strategies used in problem solving; • give oral, pictorial, symbolic (diagrams) or written responses to questions on topics presented in class.
Basic	**High school ELL students performing at the basic level:** • use rational numbers to solve problems; • demonstrate problem-solving strategies; • break tasks into smaller parts and make connections to prior knowledge; • recognize, compare, and use appropriate number terms; • respond to yes or no questions and to problems presented pictorially or numerically in class.
Emergent	**High school ELL students performing at the emergent level:** • solve numerical (not word) problems using addition, subtraction, multiplication, and division; • use integers to solve simple problems; • copy and write numerical symbols; • imitate pronunciation of numbers and mathematical terms; • use non-verbal communication to express mathematical ideas.
Pre-emergent	**High school ELL students performing at the pre-emergent level:** • observe and model appropriate cultural and learning behaviors from peers and adults; • listen to and observe comprehensible instruction and communicate understanding non-verbally.

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Student Work Samples

As you examine the samples, consider the following questions:

- In light of the standard/s addressed and the assessment tools provided, what evidence does the work provide that students are achieving proficiency in the knowledge and skills addressed by the standard/s for the task?
- Is the task/activity well designed to help students acquire knowledge and demonstrate proficiency? Is the task/activity clearly aligned with the standards? In what ways would you adapt the task/activity to better meet the needs of your students?

Student #1 Work Sample

Lump Sum Payment Option

$1800 for 18 days

$100/day

Jacque

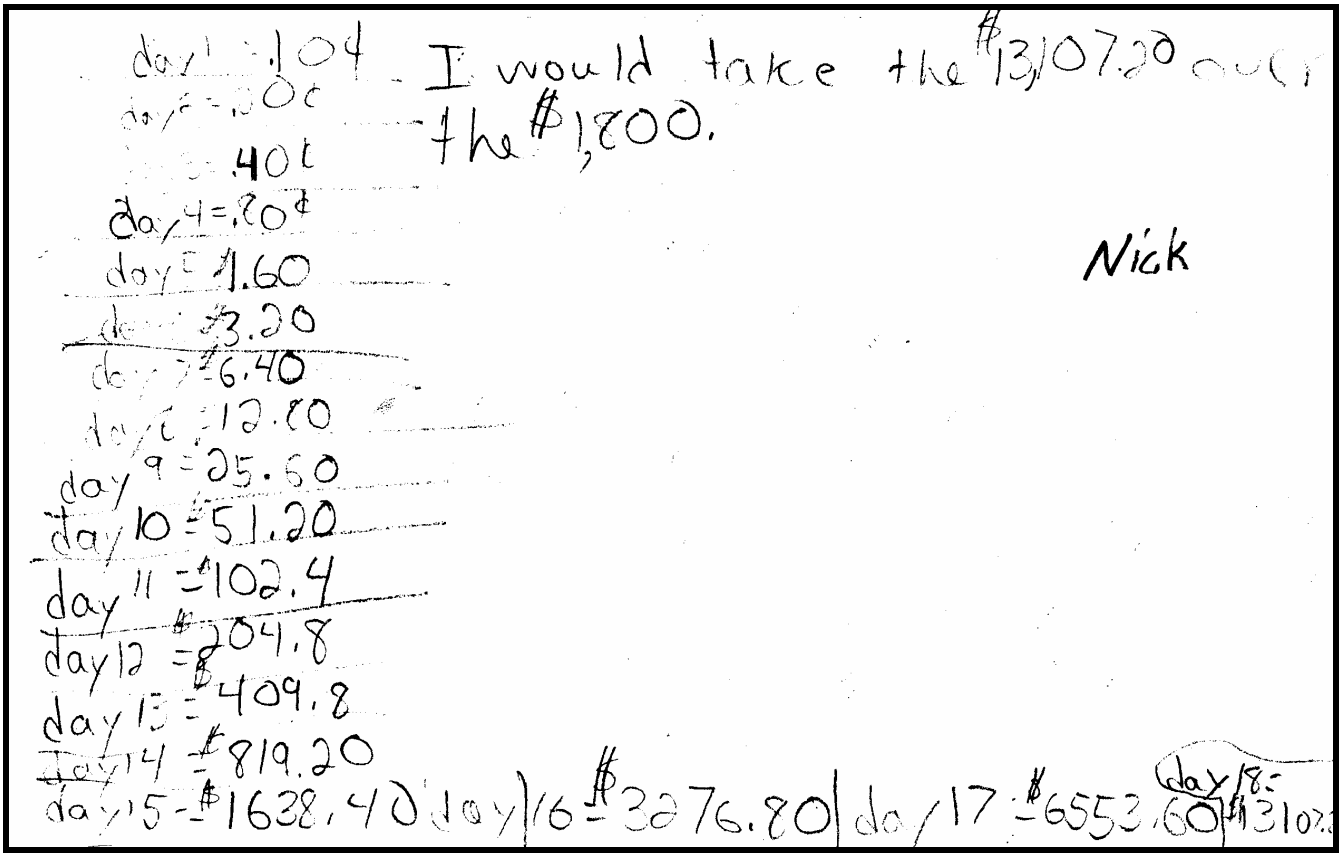
Daily Payment Option

Day #1	$0.01	Day #11	$10.24
Day #2	$0.02	Day #12	$20.48
Day #3	$0.04	Day #13	$40.96
Day #4	$0.08	Day #14	$81.92
Day #5	$0.16	Day #15	$163.84
Day #6	$0.32	Day #16	$327.68
Day #7	$0.64	Day #17	$655.36
Day #8	$1.28	Day #18	$1310.72
Day #9	$2.56		
Day #10	$5.12	Total	$2621.43

I would choose the daily payment option because it would pay $821.43 more than the lump sum payment option. My only concern is that if I am sick for one day I would end up making less than I would if paid on the lump sum payment option.

Looking at Student Work – Instructor notes and rating for work sample #1:
Based on the assessment rubric, I would rate this student as being advanced. Calculations made are accurate and conclusions are reasonable.

Student #2 Work Sample



Looking at Student Work – Instructor notes and rating for work sample #2:
Based on the assessment rubric, I would rate this student as basic. The student is able to generate a form of number pattern but does not use correct monetary values. A conclusion is reached but is not very convincing.

INSTRUCTIONAL NOTES

Author comments

This activity was given in the fall to students who were enrolled in algebra I.

Task Extensions

Change the perplexing salary offer and number of days worked. For example ask "Would you be willing to give all money earned by the 29^{th} day to receive the 30^{th} day's earnings?.

This task is also a good introductory activity to do just before studying arithmetic and geometric sequences wherever it occurs in your curriculum.

Common Strategies

Organization is probably the most critical aspect of this task if students are to be successful.

Appropriate Technology

Any type of calculator

Resources

SD Mathematics Content Standards
http://www.doe.sd.gov/contentstandards/math/index.asp

SD Assessment and Testing
http://www.doe.sd.gov/octa/assessment/index.asp

The National Assessment of Educational Progress (NAEP)
http://www.doe.sd.gov/octa/assessment/naep/index.asp

National Council of Teachers of Mathematics
http://nctm.org/

Looking at Student Work
http://www.lasw.org/index.html